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(21) International Application Number: PCT/GB97/02343 (22) International Filing Date: 1 September 1997 (01.09.97) (30) Priority Data: 9618488.2 5 September 1996 (05.09.96) GB (71) Applicant (for all designated States except US): SCAPA GROUP PLC [GB/GB]; Oakfield House, 93 Preston New Road, Blackburn, Lancashire BB2 6AY (GB). (72) Inventors; and (75) Inventors/Applicants (for US only): SAWYER, Dudley, Noel [GB/GB]; 14 Sadlers Wells, Bunbury, Tarporley, Cheshire CW6 9NU (GB). ARTINGSTALL, Lai, Ping [GB/GB]; 111 Stamford Road, Audenshaw, Manchester M34 5WB (GB). PRESTON, Joseph [GB/GB]; 39 Cloverfields, Haslington, Crewe, Cheshire CW1 5AL (GB). (74) Agents: GOODWIN, Mark et al.; Wilson Gunn M'Caw, 41-51 Royal Exchange, Cross Street, Manchester M2 7BD (GB).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>
(54) Title: WIRE COATING COMPOSITION (57) Abstract A wire coating composition comprises polypropylene polymer or copolymer and magnesium hydroxide provided with a hydrophobic coating. The wire coating composition does not contain any halogen and is essentially free of phosphorus and phosphorous compounds and phosphorous salts. Furthermore the coating is free of polyethylene wax.		

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WIRE COATING COMPOSITION

The present invention relates to a wire coating composition. The term "wire" used herein embraces both wires and cables.

It is conventional to provide a polymeric insulation coating around wires and cables. Such coatings are often made from halogenated polymers, such as polyvinyl chloride (PVC). The main problem of PVC and other halogenated polymers is that upon combustion a large volume of toxic, acidic and highly corrosive hydrogen halide smoke is liberated. As a consequence halogen-free polymer compositions for coating cables or wires have been developed. Examples of such compositions are included in EP 082407A, EP 488381A and US 5032321. These and other prior art halogen-free coating compositions, which are based upon thermoplastic polymer/mineral filler mixtures, possess inadequate ageing properties, electrical insulation properties and temperature stability. These coating compositions have a maximum temperature range of only 70-80°C. These compositions also have poor ageing properties. Furthermore, the extrusion speed for compositions of the type disclosed in EP 082407A, EP 488381A and US 5032321 may only be one fifth of that for PVC. Similar compositions containing intumescent system flame retardants, such as ammonium polyphosphate, have also been shown to exhibit inadequate electrical resistance due to the fact that the flame retardant attracts moisture and therefore increases the electrical conductivity of the material. It is noted that conventional phosphorous-based flame retardants are present in relatively large amounts, usually up to 40 php for ammonium polyphosphate.

A disadvantage with red phosphorous-based systems is that the cable coatings have a strong red colouring, which is disadvantageous for electrical cable coatings in

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general.

The aim of the invention is to provide a recyclable and/or reprocessable halogen-free coating composition with improved ageing resistance, electrical insulation and temperature resistance properties without a deterioration in other physical properties, such as tensile strength or flexibility. Such a cable coating would be ideal for use in lighting cable coatings for ships.

According to the present invention there is provided a wire coating composition comprising polypropylene polymer or copolymer and magnesium hydroxide provided with a hydrophobic coating and wherein the wire coating composition does not contain any halogen and is essentially free of phosphorous and phosphorous compounds and phosphorous salts, and is furthermore free of polyethylene wax.

The term "essentially" is used herein to mean that the composition is free from "phosphorous" or compounds or salts thereof or has a phosphorous content of less than 800 ppm.

The wire coating composition of the present invention exhibits the required coating characteristics, but unlike some PVC compounds is readily recyclable. The coating composition of the invention further provides the required electrical insulation, while being flexible, flame resistant, heat stable to greater than 125°C, abrasion resistant, readily extrudable and recyclable.

The components of the composition are ideally present in the following ratio:

polypropylene	100 php (parts per hundred polypropylene); and
magnesium hydroxide	100 to 200 and ideally

(coated)

substantially 140 php.

The coating compositions are particularly useful for cables in ships, such wires being subjected to high temperatures and contact with sea water and fluids such as fuel oil typically found in ships. It is necessary for wire coating materials to have a temperature rating of greater than 100°C, at which temperature the coating should remain stable and retain electrical insulation properties. The coating compositions according to the invention possess a temperature rating of greater than 125°C. The temperature rating is the maximum temperature at which a given insulation or jacket may be safely maintained during continuous use without incurring any thermally-induced deterioration.

In order to satisfy the ageing requirements of cables for use in ships the cable coating must meet the demands of IEC 92-351, i.e. they must have a retention of at least 70% in tensile strength and elongation at break following 7 days storage at 135±2°C.

The magnesium hydroxide acts as a filler and flame retardant. In order to overcome the problems of moisture attraction associated with intumescent flame retardant systems, the magnesium hydroxide particles are coated with a hydrophobic material such as an alkyl silane, for example a trimethoxysilane or triethoxysilane. The coating enhances adhesion between the filler particles and the polymer matrix, improves the abrasion resistance of the coating and most importantly, due to its hydrophobic nature, increases the resistance of the coating to moisture entrapment thereby maintaining electrical insulation properties. Magnesium hydroxide is also stable at high temperature, whilst its low surface area gives it a low viscosity. It is

therefore easy to process.

The preferred amount of 140 php magnesium hydroxide content gives the ideal balance between flame retardance and flexibility. A high filler content gives excellent flame retardance. However, at the same time the coating will become much less flexible such that the coated wire will fail a standard conductance test whereby a wire is tightly coiled (typically around 1mm diameter mandrel) and stored in hot water (normally 80°C) whilst under high voltage. If the coating is not flexible enough then it will crack at the coil heads.

A further advantage of the compositions according to the invention is that they can be extruded onto wire or cable using existing extrusion equipment at speeds similar to that of PVC coatings.

A cost saving may be made by using the coating compositions of the invention using the high temperature rating of the coatings. Normally a copper wire becomes hot due to the conduction of the electrical current. The high temperature rating of the coating means that the thin layers of coating can be used on thin wires, representing a saving of expensive copper.

A preferred embodiment of the invention involves the incorporation into the composition of a synergistic blend of an anti-oxidant derived from phenol and anti-oxidant based upon a phosphite. Suitable anti-oxidants are those marketed by Ciba-Geigy under the trade marks IRGANOX and IRGAFOS. Such anti-oxidants are present in an amount of only 0.1 to 5 php. Such phosphite contents are sufficiently low to have a negligible moisture attraction capability. In such compositions good processability is retained without adversely affecting the other physical properties of the coating. This aids further reprocessing of the coatings and therefore improves the

recyclability of the compositions.

The polymeric composition of the invention may optionally further comprise additives such as stabilisers, plasticisers, lubricants and further flame retardants.

In order that the invention may be more readily understood a specific embodiment of the invention is now described in detail.

Example 1

A composition was made from the following formulation

100 php	Moplen D50G
140 php	Magnefin SE630
2.4 php	Araldite GT 7072
0.5 php	Calcium stearate
1.5 php	stearic acid
2 php	Ultranox 815A

(php = parts per hundred parts of polymer)

1. Moplen D50G is a trade name of Himont for a propylene copolymer.
2. Magnefin SE630 is a trade name of Martinswerk for magnesium hydroxide.
3. Araldite GT7072 is a tradename of Ciba-Geigy for an adhesion promoter.
4. Ultranox 815A is a GE Speciality Chemicals tradename for a 50/50 weight ratio free flowing blend of Ultranox 626 (tradename for bis-(2,4-di-t-butylphenyl) pentaerythritol diphosphite, an anti-oxidant) and Ultranox 210 (tradename for tetrakis-[methylene-(3,5-di-t-butyl-4-hydroxyhydrocinnamate)]-methane, an anti-oxidant).

A cable coating prepared from this compound gave the following properties:

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<u>Properties</u>	<u>Test Method</u>	<u>Units</u>	<u>Typical Value</u>
Tensile strength	IEC 811-1-1	MPa	> 10
Elongation at break	IEC 811-1-1	%	> 350
Tear Strength	BS 6469:99.1	N/mm	12
After Ageing 7 days at 135°C	IEC 811-1-2		
Retention of tensile strength		%	85
Retention of elongation		%	75
<u>Thermomechanical Properties</u>			
Hot pressure at 135°C	IEC 811-3-1	%	5
Cold impact at -40°C	IEC 811-1-4		No cracks
Cold bend at -40°C	IEC 811-1-4		No cracks
<u>Fire and Smoke Test Properties</u>			
Oxygen index	ISO 4589-2	%	28
Halogen acid gas evolution	IEC 754-1	%	0
Corrosivity of gases	IEC 754-2		
pH			4.3
Conductivity		μS/cm	9
Smoke density - Flaming mode	ASTM E-662	Ds max	54
Time to maximum		minutes	19
Smoke density - Non flaming mode	ASTM E-662	Ds max	205
Time to maximum		minutes	20
Toxicity index	NES 713		1.4

Oil Resistance Properties

Medium	Temperature	Duration	Retention of tensile strength %	Retention of elongation at break %
ASTM 2	23°C	7 days	101	90
ASTM 2	70°C	4 hours	97	85
DIESEL	23°C	7 days	103	70
DIESEL	70°C	4 hours	103	80

	TEST METHOD	UNIT	TYPICAL VALUE
ELECTRICAL PROPERTIES			
Dielectric constant at 1 MHz	ASTM D-150		2.94
Dissipation factor at 1 MHz	ASTM D-150		0.002
Insulation resistance at 20°C	BS 6469:99.2		
Initial value		ohm.cm	10^{15}
After 21 days immersion in water		ohm.cm	10^{14}
Insulation resistance after 2 hours	BS 6469:99.2		
at 70°C		ohm.cm	3×10^{13}
at 80°C		ohm.cm	1×10^{13}
at 90°C		ohm.cm	6×10^{12}

OTHER PROPERTIES

Specific gravity	ASTM D-792	g/cc	1.40
Hardness	ASTM D-2240	Shore D	73
Melt flow index	IEC 811-4-1	g/10min	0.1

It is to be understood that the embodiment described above is by way of illustration only. Many modifications and variations are possible.

CLAIMS

1. A wire coating composition comprising polypropylene polymer or copolymer and magnesium hydroxide provided with a hydrophobic coating and wherein the wire coating composition does not contain any halogen and is essentially free of phosphorous and phosphorous compounds and phosphorous salts, and is furthermore free of polyethylene wax.
2. A wire coating composition as claimed in claim 1, wherein the composition comprises from 100 to 200 parts per hundred parts of polypropylene of magnesium hydroxide.
3. A wire coating composition as claimed in claim 1 or claim 2, wherein the composition comprises substantially 140 parts per hundred parts of polypropylene of magnesium hydroxide.
4. A wire coating composition as claimed in any preceding claim, wherein the coating composition has a temperature rating of greater than 125°C.
5. A wire coating composition as claimed in any preceding claim, wherein the said hydrophobic coating comprises an alkyl silane.
6. A wire coating composition as claimed in claim 5, wherein the alkyl silane comprises a trimethoxysilane or triethoxysilane.
7. A wire coating composition as claimed in any preceding claim, wherein the composition comprises from 0.1 to 5 parts per hundred parts of polypropylene of anti-oxidant.
8. A wire coating composition as claimed in claim 7, wherein the anti-oxidant comprises a blend of bis-(2,4-di-t-butylphenyl) pentaerythritol diphosphite and tetrakis-[methylene-(3,5-di-t-butyl-4-hydroxyhydrocinnamate)]-methane.

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9. A wire coating composition substantially as defined herein with reference to the example.

INTERNATIONAL SEARCH REPORT

Inter. nal Application No
PCT/GB 97/02343

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01B3/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CHEMICAL ABSTRACTS, vol. 123, no. 6, 7 August 1995 Columbus, Ohio, US; abstract no. 58393, page 131; XP002045300 see abstract & JP 07 094 028 A (HITACHI CABLE) 7 April 1995	
A	DE 26 46 965 A (TAKAHASHI HIROSHI) 21 April 1977	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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